JUPITER MISSILE SHOT—BIOMEDICAL EXPERIMENTS

THE UNIVERSITY OF MICHIGAN
SEP 17 1959
MAIN READING ROOM

HEARING

BEFORE THE

COMMITTEE ON SCIENCE AND ASTRONAUTICS U.S. HOUSE OF REPRESENTATIVES

EIGHTY-SIXTH CONGRESS

FIRST SESSION

JUNE 3, 1959

[No. 35]

Printed for the use of the Committee on Science and Astronautics

UNITED STATES
GOVERNMENT PRINTING OFFICE
44262 WASHINGTON : 1959

COMMITTEE ON SCIENCE AND ASTRONAUTICS

OVERTON BROOKS, Louisiana, *Chairman*

JOHN W. McCORMACK, Massachusetts
GEORGE P. MILLER, California
OLIN E. TEAGUE, Texas
VICTOR L. ANFUSO, New York
B. F. SISK, California
ERWIN MITCHELL, Georgia
JAMES M. QUIGLEY, Pennsylvania
DAVID M. HALL, North Carolina
LEONARD G. WOLF, Iowa
JOSEPH E. KARTH, Minnesota
KEN HECHLER, West Virginia
EMILIO Q. DADDARIO, Connecticut
WALTER H. MOELLER, Ohio
DAVID S. KING, Utah
J. EDWARD ROUSH, Indiana

JOSEPH W. MARTIN, JR., Massachusetts
JAMES G. FULTON, Pennsylvania
GORDON L. McDONOUGH, California
J. EDGAR CHENOWETH, Colorado
FRANK C. OSMERS, JR., New Jersey
WILLIAM K. VAN PELT, Wisconsin
A. D. BAUMHART, JR., Ohio
PERKINS BASS, New Hampshire
R. WALTER RIEHLMAN, New York

CHARLES F. DUCANDER, *Executive Director and Chief Counsel*
DR. CHARLES S. SHELDON II, *Technical Director*
SPENCER M. BERESFORD, *Special Counsel*
PHILIP B. YEAGER, *Special Consultant*
JOHN A. CARSTARPHEN, JR., *Counsel*
RICHARD P. HINES, *Staff Consultant*
Lt. Col. PAUL B. SCHUPPENER, *Staff Consultant*
RAYMOND WILCOVE, *Staff Consultant*

DEPOSITED BY THE
ED STATES OF AMERICA

CONTENTS

Statement of—
Low, George, Chief of Manned Space Flight Programs, NASA, accompanied by Col. Robert Holmes, Chief, Biophysics and Astronautics Branch, Army R. & D. Command, and Capt. William Augerson, USA Medical Corps, now assigned to NASA Space Task Group ..... Page 2
Worf, Dr. Douglas, Chief, Biology and Life Support Systems, NASA 13

JUPITER MISSILE SHOT—BIOMEDICAL EXPERIMENTS

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
Washington, D.C., Wednesday, June 3, 1959.

The committee met, pursuant to adjournment, at 10 a.m., Hon. Overton Brooks (chairman) presiding.

The CHAIRMAN. The committee will please come to order.

Mr. Ducander, would you read this letter that I have caused to be written to Hon. W. J. McNeil? I think it should be read to the committee.

Mr. DUCANDER. A letter from the chairman to Hon. W. J. McNeil, Assistant Secretary of Defense, Washington, D.C.

DEAR MR. SECRETARY: Our thoughts are with you and your family at this time of your great loss. The members of the Committee on Science and Astronautics join me in extending to you our sympathetic understanding. It is with deep humility, Mr. Secretary, that I say to you and your family that your loss can be only partially reconciled to the courageous sacrifice that was your son's in the service of our country.

Under the circumstances, should you so desire, you may appear before the Science and Astronautics Committee on a date other than June 8, 1959, for which I would be glad to make the necessary arrangements.

Sincerely yours,

The CHAIRMAN. I might say to the members of the committee, Mr. McNeil is scheduled to be a witness Monday. For that reason I thought it wise that I write the letter on behalf of the committee. Whatever his desire is, the action will be satisfactory with the committee.

This morning we have first an NASA briefing on the Jupiter shot May 28, carrying monkeys in the missile's nose cone. The witnesses are Capt. William Augerson, USA Medical Corps, now assigned to NASA Space Task Group; George Low, Director of Manned Space Flight Division, NASA; Dr. Douglas Worf, Chief of Biology and Life Support Systems, NASA; and Col. Robert Holmes, Chief, Biophysics and Astronautics Branch, Army R. & D. Command. Who is our first witness?

Mr. Low. I am Mr. Low. I would like to start it off.

The CHAIRMAN. You are the first witness, Mr. Low?

Mr. Low. Yes, sir.

The CHAIRMAN. Do you wish anybody to sit with you, Mr. Low?

Mr. Low. I would like Colonel Holmes and Captain Augerson to sit with me.

STATEMENT OF GEORGE LOW, DIRECTOR OF MANNED SPACE FLIGHT DIVISION, NASA; ACCOMPANIED BY COL. ROBERT HOLMES, CHIEF, BIOPHYSICS AND ASTRONAUTICS BRANCH, ARMY R. & D. COMMAND, AND CAPT. WILLIAM AUGERSON, USA MEDICAL CORPS, NOW ASSIGNED TO NASA SPACE TASK GROUP

Mr. Chairman, as you know, the United States launched a Jupiter intermediate range ballistics missile on May 28. Since there was space available in the nose cone of that missile, some biomedical experiments were conducted on a noninterference basis. These experiments were conducted by the Surgeons General of the Army and the Navy in support of NASA programs.

Colonel Holmes of the Army Research and Development Command is going to describe the details of the aeromedical experiments.

The CHAIRMAN. Colonel Holmes, would you just proceed, sir, in your own way, unless you have a prepared statement?

Colonel HOLMES. No, sir; I have no prepared statement.

The experiment was divided between the Army and the Navy. Two animals were used, a rhesus monkey and a squirrel monkey.

The basic objectives of the experiments were rather obvious. We had tried a previous experiment in December in which we were able to telemeter basic physiologic data from space; but we had an unfortunate situation in which it was impossible to effect recovery of the capsule, so we were not able to follow that experiment through the stresses of reentry. That was obviously one of our primary concerns; to study an animal as it leaves the earth's surface and enters space and returns into the earth's atmosphere.

The experiment was designed to provide basic data on the respiration, pulse rate, the pulse velocity, the behavior of the heart, the electrocardiogram, and the muscular activity. We had also designed a psychobehavioral test in which the rhesus monkey would receive a shock and would be trained to push a little lever to cut off that shock. This would give us some estimate of how he could perform in space.

I believe that the experiments in general were quite successful. Our instrumentation was good with the exception of one fault, in which the electronic device for the psychobehavioral test did not function as it had in the checkout, and at the last moment we had to discontinue that particular phase of the test.

I believe some comments appeared that were not entirely correct—that the animal failed to perform the test. I would like to correct that impression. The animal did not try to perform the test. The electronic device was not utilized for that purpose, because we received interference with some of our other measurements and we felt it best not to use that particular phase of the experiment.

In addition to the information on the animals and their metabolic level, we also received telemetering information on the environmental circumstances of the cabin or the capsule in which the animals were housed. This related to temperature, to pressure, and to humidity.

These conditions were well controlled throughout the flight. There was very little variation in the temperature, pressure, and humidity, and although we have not had time to go over the data we received on the physiologic levels, in general I can state that the experience we gained on the first experiment was largely repeated.

We noted accelerations of respirations and pulse, but the heart behavior, et cetera, were quite satisfactory, and whatever excitation occurred was completely adapted for and the animals behaved well throughout the flight and were recovered alive.

Their condition following recovery was excellent and at the press conference on Saturday I would say that both animals performed quite well—perhaps better than some of the others of us—but I think they did perform quite well.

We feel that there was no clinical evidence, at least of residua, that might be related to the experience they had in flight.

I believe that, sir, summarizes the broad details of the experiment.

The CHAIRMAN. Mr. Anfuso.

Mr. ANFUSO. Thank you, Mr. Chairman, for permitting me to ask this question because I have to leave in a few minutes.

I understand, according to the newspapers, that death was attributed to the effect of anesthesia?

Colonel HOLMES. That is correct.

Mr. ANFUSO. Have we had any previous deaths from anesthesia, monkeys or other animals?

Colonel HOLMES. We have not had any experience in our laboratory with that, but I feel every laboratory that has large primate colonies must have had deaths from anesthesia. The Surgeon General has such information regarding the use of anesthetics. Fortunately, it is a very rare occurrence and unfortunately it happened to us at this time.

Mr. ANFUSO. What I am getting at is this: Have all other causes been removed, such as the effects of outer space and the flight this monkey went through in outer space? After all, what do we know about outer space; what biological information do we have; what medical knowledge do we have?

Have all those possibilities been excluded? Do we know that death was not caused by fright or something that happened in outer space?

Colonel HOLMES. Your question is certainly well placed and it takes us from the level, you might say, of pure medical observation, perhaps into the area of conjecture.

Clinically, so far as we were able to determine, the animals, both of them, were returned in excellent condition.

Now, as you know, this resolves itself into a clinical estimate of the situation. What might have happened, as the time unfolded, and went by, weeks or months, no one will ever be able to say, but——

Mr. ANFUSO. When you put in the instruments, you gave an anesthesia, I assume?

Colonel HOLMES. That is right.

Mr. ANFUSO. And the monkey had no ill effects from that?

Colonel HOLMES. It went along all right.

Mr. ANFUSO. The same method of giving the anesthesia was used; was it not?

Colonel HOLMES. Yes, that is correct.

Mr. ANFUSO. I would suggest, sir, that perhaps this committee would be interested in a further report as to the exclusion of all possible causes because, after all, you hope to get man into space and monkeys are pretty close to man—so they say. There was a long debate over this at one time.

Before we send man into space, we should be satisfied that all other possible causes have been removed. Do you think we could get a full medical and biological report on that?

Colonel HOLMES. We are having an autopsy performed. The animal was brought to the Armed Services Institute of Pathology yesterday. An autopsy was performed. I do not have a report at this time. I am sure we are just as much concerned as you about the matter you expressed.

The fact remains, the animal was going along very well and an anesthetic was given. That was the precipitating agent.

What the other matters are is, as I stated before, conjectural at this point. It may be we will not, from the autopsy, find anything significant and this question will always remain.

(The information requested is as fallows:)

NATIONAL AERONAUTICS AND
SPACE ADMINISTRATION,
Washington, D.C., June 9, 1959.

Memorandum.
To: Committee on Science and Astronautics.
Subject: Jupiter—Biomedical Experiments.

Immediately after her arrival from Puerto Rico, monkey Able was taken to the Walter Reed Army Institute of Research low level whole-body counting facility, and carefully examined. Low-normal amounts of natural potassium were found. There was no indication of gamma ray activity found in the monkey.

After her death, an autopsy was conducted at the Armed Forces Institute of Pathology, which revealed no evidence of radiological injury. Final histological examinations will not be completed for 3 or 4 weeks but it can be concluded at this time that there was no measurable evidence of exposure to neutrons or high energy electrons which could have caused any radiation effect.

Mr. ANFUSO. Thank you very much.

The CHAIRMAN. Let me ask the witness this: Was the animal behaving as a normal animal of that character should behave after the experiment?

Colonel HOLMES. Yes, sir. The animal behaved quite well, as was noted on her arrival here in Washington. It had a smooth flight to our Medical Research Lab at Fort Knox and the clinical assessment of the animal at that time was that she was in excellent condition.

The CHAIRMAN. You had a chance to view and observe the actions of the animal before and after the flight because you had her a long time?

Colonel HOLMES. Yes, sir.

The CHAIRMAN. Would you say the animal was acting normally, just as it did before the flight?

Colonel HOLMES. Yes, sir; we felt that it was.

The CHAIRMAN. What sort of incisions did you have to make in order to place the electrodes in?

Colonel HOLMES. It is a very minor operation. A little nick is made in the skin, less than a centimeter, and a small electrode is put in. The condition that brought the use of this anesthetic about was that there was a little infection around the electrode and, as I am sure all of you know, it is an axiom in surgery that where there is some pus, let it out. You want to remove the foreign body as soon as possible to allow healing; the medical indication was to clear up this little bit of infection as soon as possible and that was the goal at the time the operation was planned. The operation was never begun, of course.

The CHAIRMAN. You feel that the death was attributable entirely to the administration of the anesthesia?

Colonel HOLMES. I feel, sir, that was the precipitating agent, and I personally feel it was probably not directly related to the flight. But I am fully aware of these other factors that have been brought up that need evaluation.

The CHAIRMAN. You say "not directly related to flight." Would you say indirectly related to flight?

Colonel HOLMES. If one considers the total stress syndrome, one might make a presumption that the animal had survived in good condition a stressful experience, but perhaps there were residua that were not clinically evaluated, that did not lend themselves to clinical evaluation.

But I believe that is serious conjecture because from all that we know about the animal, the animal appeared to be in good condition.

The CHAIRMAN. Mr. Miller.

Mr. MILLER. How old was the animal?

Colonel HOLMES. Sir?

Mr. MILLER. How old was Able?

Colonel HOLMES. I do not have the exact age for you. We are obtaining that. The age that I have at hand now is a little better than a year, figuring from the weight of the animal and the information that we have.

Mr. MILLER. Then it was a young, vigorous animal?

Colonel HOLMES. Yes, sir.

Mr. MILLER. It was not an old one?

Colonel HOLMES. No, sir.

The CHAIRMAN. Mr. Bass.

Mr. BASS. What was the nature of the anesthesia you administered to the monkey?

Colonel HOLMES. This is an induction-type anesthetic. It is trichloroethylene, which is utilized in many places to quiet an animal for a very minor procedure. It is not a long-lasting type of anesthetic which gives a rapid result. It is used for very routine anesthetic procedures which should be quickly done and over with.

Mr. BASS. Was it administered intravenously?

Colonel HOLMES. No, sir; it was an inhalant.

Mr. BASS. Something in the nature of ether?

Colonel HOLMES. Yes, sir.

The CHAIRMAN. Mr. Roush.

Mr. ROUSH. Had this animal been given the same anesthetic before?

Colonel HOLMES. Yes, on two occasions before.

Mr. ROUSH. Before its space flight?

Colonel HOLMES. Yes.

Mr. ROUSH. Had there been any adverse reaction as a result of the giving of that anesthetic?

Colonel HOLMES. No, sir; the animal fared very well.

Mr. ROUSH. Is it unusual that there would be a reaction once and not another time?

Colonel HOLMES. It could occur both ways.

We do not have a large body of experience on anesthetic deaths in animals at the moment. I assure you we are going to try to learn everything we can about it very quickly.

44262—59——2

Mr. ROUSH. We cannot say the animal was allergic to this particular category?

Mr. GLEASON. Could Mr. Augerson comment?

Captain AUGERSON. I did a little homework yesterday. The basic reference is Goodman and Gillman, which is quite a standard book in pharmacology. This reference states that trichloroethylene—or trilene, as it is abbreviated—is in many ways similar to chloroform, in that it is potentially toxic to heart and liver.

This does not mean that it should not be used, but it means you have to accept a certain risk. The reference text also states, page 72, that deaths from ventricular fibrillation or cardiovascular arrest have been reported. They say that this is rare, but it is mentioned.

I would comment that one of the other monkeys that we worked with, down at Cape Canaveral, using this agent, did not have fibrillation, but it showed that the heart muscle was more irritable, following the use of this drug, and developed an abnormal electrocardiogram that showed frequent extra little beats.

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. Would you say, then, this monkey died of heart failure, or did it die from a respiratory failure?

Captain AUGERSON. I was not present at the death.

Mr. FULTON. In your judgment.

Colonel HOLMES. I was present, sir, at the time of the death and we had electrocardiograms that were being taken at that time and the pattern was that of a ventricular fibrillation so we would say it was a cardiac death.

Mr. FULTON. Was really heart failure?

Colonel HOLMES. Yes.

Mr. FULTON. Was there any particular strain put on the heart of this monkey, according to your instruments and reports?

Colonel HOLMES. During the space flights?

Mr. FULTON. Yes.

Colonel HOLMES. The data that I have been able to study thus far showed that, in the countdown before takeoff, the electrocardiogram (the heart activity) was very good. Just before takeoff we had a little instrumental difficulty with the E.K.G.

Mr. FULTON. What is E.K.G.?

Colonel HOLMES. Electrocardiogram.

Mr. FULTON. All right.

Colonel HOLMES. But fortunately we were able to get the heart sound quite clearly and distinctly and that gave us reason to believe the heart was behaving quite well.

Mr. FULTON. When this monkey took off it was subject to very high decibels of noise and a tremendous roaring sound. What effect do you think that might have had on scaring the monkey?

Colonel HOLMES. Well, we know that noises can be a stressful agent, but whatever the effect was on the monkey, he seemed or she seemed to bear up under it quite well and adjust to the stimuli that were coming in at that time.

Mr. FULTON. Why do American scientists, as well as the Russian scientists, always pick female animals to go up?

Colonel HOLMES. I don't know.

Mr. FULTON. Are they more hardy? Do they last longer or what?

Colonel HOLMES. I think we have data to the effect that the female is the more hardy of the species.

Mr. MILLER. I wonder if the gentleman would mind a quotation from Kipling. The female is more efficient than the male.

Mr. FULTON. More deadly.

The question—why should we not have seven women as astronauts rather than seven young men? From the scientific point of view, is there any reason why they are not all women?

Mr. GLEASON. Mr. Low?

Mr. LOW. Mr. Fulton, let me go back to the criteria we used in selection of the astronauts.

We decided that the type of experience that would be best suited to the space flight was that of a qualified jet pilot, and an experimental test pilot. I know of no women that meet these qualifications.

Mr. FULTON. You automatically exclude them by setting up your tests; is that right?

Mr. LOW. We did not intentionally exclude them, but this was the effect.

Mr. FULTON. It was the final effect?

Mr. LOW. Yes.

Mr. FULTON. Is there any reason why you, as scientists, choose female animals for your experiments and then switch to male human beings? You see, it is more than a specific instance. It is almost a pattern with you and the Russians.

Mr. LOW. It is my understanding there were male and female animals in the colony and the final choice had nothing to do with the sex of the animal.

Colonel HOLMES. That is right.

Mr. FULTON. I know I have seen one called Sam. I thought he was going to go. I wondered why all the males had been excluded and the females sent up by you scientists. It seems peculiar to me.

Colonel HOLMES. I think you are raising a very interesting question that we will think about perhaps a little more.

Mr. FULTON. There is no scientific basis, then, for thinking that you and the Russian scientists feel the female animals either react better, act better, or scare less?

Colonel HOLMES. I do not believe that has been well founded experimentally. I would yield to someone else's information if they have it at that point, but I don't believe so.

The CHAIRMAN. Mr. Bass.

Mr. BASS. I understood two monkeys went up, one male and one female.

Colonel HOLMES. No, two females; one a squirrel monkey supplied by the Navy and a rhesus monkey supplied by the Army.

Mr. FULTON. What happened to the Air Force monkey? They were specially trained for months.

Colonel HOLMES. This was a different experiment. This was an Army-Navy joint project and not involved with the Air Force experiment.

Mr. FULTON. I will finish with this. Did you have any instrumentation to determine the effect of outer cosmic rays on these monkeys? For example, we are protected from these cosmic rays because the earth's atmosphere protects us. When we have these tremendous onslaughts of cosmic rays at a high altitude, my query is this: Might it not have been the effect of cosmic rays in outer space going through these monkeys, which you did not record, which really killed this monkey, rather than the heart attack?

Colonel HOLMES. I know the heart attack killed the monkey regardless of what the cause had been.

Mr. FULTON. The monkey, as demonstrated here, had the same type of anesthesia before and had successfully withstood it?

Colonel HOLMES. Yes, sir.

Mr. FULTON. Therefore, there must have been some other added circumstances. One of them, of course, could have been the tremendous impact of cosmic rays that go right through the body; is that not right?

Colonel HOLMES. That is correct. But in this instance we know that our precipitating agent was the anesthetic and in answer to your question about the determination of cosmic ray influence, we did have additional packages aboard which involved the use of onions and the use of mustard seed and the use of corn.

Mr. FULTON. What instrumentation did you have for cosmic rays? How much more force of cosmic rays than is normal on the earth's surface was the monkey subjected to?

Colonel HOLMES. I do not have the results of that part of the experiment. We did not have any instrumentation for cosmic ray detection, but the additional experimental packages I just mentioned will indicate the cosmic ray activity.

Mr. FULTON. Is this any indication that it acts as quickly as this, within a day or so? At Hiroshima, were the radiation effects fatal within 48 hours?

Colonel HOLMES. That depends upon the intensity of the radiation received. I happened to be Director of the Atomic Bomb Commission in Hiroshima for 3 years. The low-grade, long-term effect was the major problem there. Whatever deaths occurred early at Hiroshima and Nagasaki occurred from a combination of reasons, thermal as well as blasting.

Mr. FULTON. Do you have any evidence the monkey's body was subjected to intensive radiation for a short space of time; that it received a sudden blast of radiation which left no indication?

Colonel HOLMES. No indication from the clinical observation that we had following the recovery. The tissues will be studied, of course, at autopsy and that report will be forthcoming.

Mr. FULTON. Was there any failure of the anesthesia equipment or any surging, or any sparking through magnetic interference of the equipment?

Colonel HOLMES. No, sir.

Mr. FULTON. You had no equipment failure at all on this anesthesia?

Colonel HOLMES. No.

Mr. FULTON. I yield to the gentleman from California.

Mr. MILLER. I just want to say this for the doctor's guidance. Mr. Fulton raised this question of male versus female, but he is a bachelor and not skilled in this field.

Mr. FULTON. I have an inquiry in mind.

Colonel HOLMES. I share Mr. Fulton's position.

The CHAIRMAN. Mr. Teague.

Mr. TEAGUE. Colonel, according to the newspapers the only time during flight when the monkeys had any particular reaction was during the reentry. Is that statement correct?

Colonel HOLMES. No, sir. That is not quite true and here again I would say that I have not studied all of our data as closely as we will

study it. I was looking at the oscillographic portion in the blockhouse. There was some acceleration of the pulse rate on takeoff. But in the broad terms I mentioned, whatever acceleration occurred in respiration and pulse settled down pretty quickly in flight. Some slight variation was noted, but I am sure we have variations right here among us from time to time, as questions might get a little more pointed or as various other things might happen.

This is within a normal range that every animal might have or every human might have. At the moment I do not believe there have been any startling changes in the basic physiological level of the animal during flight.

Mr. TEAGUE. During reentry or any other time?

Colonel HOLMES. At reentry there were more significant changes, but I will have to look at that more closely. Whatever they were, the animal adapted for them, or recovered from them, quite well, and on recovery was in good shape.

The CHAIRMAN. You said there were slight indications of change in pulse at the takeoff?

Colonel HOLMES. Yes, sir.

The CHAIRMAN. How slight were they, or how intense were they?

Colonel HOLMES. For instance, let us take the pulse rate of the rhesus, which might have a range at rest of about 140 to 160.

This would go up perhaps to 200, and then trail off very lightly. If you were to be given a physical examination and asked to jump 12 or 15 times on 1 leg and then 12 or 15 on the other, your heart rate or pulse rate would go up, depending upon your overall physical condition; it would settle back down at a more or less predictable rate. This animal did that.

Mr. TEAGUE. What were the figures on reentry, then?

Colonel HOLMES. On reentry I believe the highest figure on the rhesus—and I am not entirely positive about this—was around 250.

Mr. TEAGUE. Is it presumed that was caused by heat?

Colonel HOLMES. I do not believe we know enough about the stresses of reentry; vibration, noise, as Mr. Fulton mentioned, and various other factors that may not be too clearly evident at this time ——

Mr. TEAGUE. Is there evidence that in the nose cone there was a lot of noise on takeoff and reentry? If you are at the front end of a jet plane you do not get all the noise that takes place behind you.

Colonel HOLMES. I do not believe our studies are complete regarding the influence of the noise or the intensity of the noise.

Mr. TEAGUE. On reentry, you do not know the cause of the increase in pulse rate?

Colonel HOLMES. We know that the accelerational rate, or the g.'s, experienced at that time is an influential factor on the pulse rate.

Mr. TEAGUE. Do you have any idea how many g.'s it reached?

Colonel HOLMES. Yes; I can say it was in the order of 30 g.'s over a short period of time.

Mr. FULTON. How long did it exceed man's 21 or 22 g.'s that we have already studied?

Colonel HOLMES. Do you have a figure on that?

Mr. LOW. I don't have the exact figures, but in all reentries the pulse is a very sharp pulse. I would guess that the time above 20 g.'s was half a minute.

Mr. FULTON. How many g.'s?

Mr. LOW. The time above 20 g.'s, I would guess, would be less than half a minute.

The CHAIRMAN. Did the colonel say 30 g.'s?

Colonel HOLMES. This was a peak.

The CHAIRMAN. Above 20?

Colonel HOLMES. Yes.

The CHAIRMAN. What was the temperature, Colonel, during that time?

Colonel HOLMES. Of the cabin or capsule containing the animals?

The CHAIRMAN. In the nose cone.

Colonel HOLMES. I don't know. That is a flight characteristic I am not familiar with.

Mr. LOW. I think the temperature in the capsule was of the order of 80° to 90°.

Colonel HOLMES. I know what our temperature was inside the capsule where the animal was held.

The CHAIRMAN. What was it there?

Colonel HOLMES. Around 68 to 70. We maintained a comfortable temperature for the animal all the way through.

The CHAIRMAN. Was the animal shielded in any way against radiation?

Colonel HOLMES. No, sir.

The CHAIRMAN. There was no shielding at all against radiation?

Colonel HOLMES. No, other than the normal equipment, our natural equipment which we had for the animal, which was aluminum, and a compound for waterproofing.

The CHAIRMAN. There was no tumbling of the nose cone?

Colonel HOLMES. Not to my knowledge.

The CHAIRMAN. It maintained a certain level or definite position?

Colonel HOLMES. Yes.

The CHAIRMAN. And on reentry there were no unusual features about the reentry problem that would excite the animal, were there?

Colonel HOLMES. Nothing unusual, sir. So far as I know, the flight pattern was as predicted and was carried out quite well.

Mr. TEAGUE. Colonel, did these monkeys go through a series of tests so that you would know they would be better for this capsule than other monkeys or did you just pick them up because they were healthy?

Colonel HOLMES. No, they were healthy, but they had gone through certain conditioning experiences before they took the flight.

Mr. TEAGUE. In other words, they had lived in this capsule before they took the flight?

Colonel HOLMES. Yes, sir.

The CHAIRMAN. Colonel, I did not quite finish my questions.

You testified about the rhesus monkey. What about the other monkey—the squirrel?

Colonel HOLMES. The behavior there paralleled the behavior of the rhesus quite well. As a matter of fact, at one time during the flight I was having trouble comparing the tracings for the two monkeys because they were going on very close together in terms of respiration. The general behavior pattern during flight was the same.

The CHAIRMAN. You received separate signals from each one?

Colonel HOLMES. Yes.

The CHAIRMAN. This experiment of having a monkey punch a button when a red light was on, you said it did not work?

Colonel HOLMES. That is right.

The CHAIRMAN. That was on account of the mechanism rather than the animal?

Colonel HOLMES. That is right. We have to be fair to the animal. We did not give him a chance to perform.

The CHAIRMAN. Did your other experimental problems work out all right?

Colonel HOLMES. Yes.

The CHAIRMAN. You got the data you were after?

Colonel HOLMES. We feel we did. We had a fault on the electrocardiogram on the rhesus monkey but on the squirrel it was good throughout flight.

The CHAIRMAN. What do you mean by a fault?

Colonel HOLMES. Something went wrong with our instrumentation. We had a good E.K.G. for a period and then it faded out and then came in.

The CHAIRMAN. Are you sure it was the fault in the instrument rather than the animal?

Colonel HOLMES. Yes, sir; you can tell an instrumental fault.

The CHAIRMAN. It happened with the rhesus rather than the squirrel monkey?

Colonel HOLMES. Yes, sir; but this was an instrumental fault.

The CHAIRMAN. Mr. Hechler.

Mr. HECHLER. I would like to address my question to Mr. Low. As a result of the computations you made, would you recommend any changes in either the capsule or the nose cone, or the position of either monkeys or human beings that go up in future flights?

Mr. LOW. I would first like to say this flight was not in direct support of the manned space flight program, Project Mercury. This was more in support of the general biotechnology programs of NASA. It did not duplicate the stresses that the astronaut will have in Project Mercury.

For instance, the g history during reentry for this flight was very much higher than we anticipate in Project Mercury. The takeoff period was not the same and the altitude was different. There is no particular relationship between this flight and Mercury flights.

I think in general terms we would make no changes in Mercury because of this flight. If anything, it gave us more confidence because the animals reacted so well in the weightless state.

Mr. HECHLER. Colonel Holmes, have you removed or do you plan to remove the electrode from the squirrel monkey?

Colonel HOLMES. The squirrel monkey, sir, is being cared for by the Navy doctors and I am not sure, but the animal is either out at Bethesda or Pensacola now. I read in the paper this morning that the electrodes had been removed successfully.

Mr. GLEASON. Captain Augerson may have more information.

Captain AUGERSON. I have a late report from the Navy on this, as of half an hour ago. It says the monkey shows no change, is perfectly normal, is gaining weight, the temperature is all right, feeding well, all of the electrodes are out, and the animal is happy. And I don't know if this next statement has anything to do with it—there is another animal in the same cage.

Mr. RIEHLMAN. Mr. Chairman, would the gentleman yield for just a question?

Do you have information on the type of anesthetic used on the squirrel monkey?

Mr. TEAGUE. It was local, according to the paper.

Captain AUGERSON. I don't know.

Mr. WOLF. I had a couple of questions on the technology.

Have they figured out what caused the failure to function of the mechanism that was supposed to flash the light?

Captain AUGERSON. That is being checked into now.

Mr. WOLF. They don't know?

Captain AUGERSON. I don't know. Perhaps someone knows at Huntsville. I don't know at this time.

Mr. WOLF. Has it been brought out what type of nose cone it was?

Mr. LOW. I don't know whether we are prepared to discuss the nose cone program itself. It was part of the Army program. I don't think we can discuss it here.

The CHAIRMAN. Mr. King.

Mr. KING. A few minutes ago I was going to ask a question. It has been partially and perhaps completely answered, but I was going to ask, as a result of all this, what general conclusions are you able to draw, or what new information has come to you as a result of this that you did not have before that would be specifically useful to us in pursuing these matters of common interest?

Would you like to generalize?

Colonel HOLMES. That, of course, is a very cogent question. We feel we have learned something very valuable. We have brought an animal back in and have observed an animal throughout an entire flight. In our December flight experiment, we got a period of takeoff and a period of weightlessness, but lost the animal on recovery. That experiment is now complete. We have a period of takeoff, a period of weightlessness, and a reentry period. Our observations of animals in the weightless state, as of 6 months ago, amounted to a matter of a few seconds. Now, on three separate occasions, we have observed animals during about 10 minutes of weightless flight.

I believe there is nothing unnecessarily duplicative about that, because our information is so scanty that all of the information we can get on the metabolic or behavioral reaction during a weightless period and reentry is extremely important. So we now have an observation which I would not really like to present as being a profound physiologic experiment, but in which we have recovered a live animal and we know what the stresses or stress reactions were during that period. This is one of the early steps for the accumulation of information that would be applicable, I think, in time to the total space exploration problem.

As Mr. Low pointed out, it is not to be directly related to Project Mercury. This contribution is to our total pool of knowledge, which has to do with the behavior of live organisms in space.

The CHAIRMAN. Mr. Riehlman.

Mr. RIEHLMAN. My question has been answered.

The CHAIRMAN. Mr. McDonough.

Mr. MCDONOUGH. Is this the highest elevation, Colonel, that we have any record of, for a living organism?

Colonel HOLMES. I believe the Russians did some quick experiments straight up and down, roughly 250 miles. These experiments, both of them, have been in the order of 300 miles in a trajectory.

Do you have any information on that?

Mr. LOW. I am reasonably sure the Russian dog in the satellite experiment went to higher altitudes in part of the trajectory. I don't have the exact numbers.

Mr. MCDONOUGH. My question is, living organisms went to this elevation and returned?

Mr. MILLER. Returned live.

Mr. MCDONOUGH. Yes, alive.

Colonel HOLMES. I do not wish to appear dogmatic, but to my knowledge I think this is the highest altitude a living animal has gone and been recovered successfully.

Mr. MCDONOUGH. What was the speed from launching speed to destination?

Colonel HOLMES. We are out of my area, but 10,000 miles per hour is the figure I have been given.

Mr. MCDONOUGH. Is it restricted as revealing any classified material on the nose cone?

Colonel HOLMES. I would think, sir, that it is.

Mr. MCDONOUGH. What condition did you find the other organisms, besides the monkeys, that returned?

Colonel HOLMES. These are mustard seed and corn and onions, and, of course, they grossly appeared unchanged.

Mr. MCDONOUGH. Was there any other animal?

Colonel HOLMES. The sea urchin egg, and I am not clear what the interpretation of that experiment is to be. That is being studied.

Mr. WOLF. Are you planning to follow through with some experiments to determine whether these seeds will grow normally? Is that the plan now?

Colonel HOLMES. Yes, sir. Their germination history will be studied.

Mr. MCDONOUGH. The point there is whether the radiation affected them?

Colonel HOLMES. Yes, sir.

Mr. MCDONOUGH. They may not have grown even if you had not exposed them to radiation.

Colonel HOLMES. Yes. At this time we do not know what we have.

Mr. GLEASON. You may want to hear a further comment from Dr. Worf who has been in charge of that.

STATEMENT OF DR. DOUGLAS WORF, CHIEF, BIOLOGY AND LIFE SUPPORT SYSTEMS, NASA

Dr. WORF. On the sea urchin eggs, the objective of this experiment was to determine whether weightlessness had any effect on the life cycle and basic metabolism of living tissues of the organisms. I was talking to Dr. Young, who conducted this experiment, the other day and he said the experiment was successful and that the Florida State University at the moment is developing the details.

The other experiment in which we had the objective of evaluating the cosmic radiation was the neurospora. There again we are determining what mutations resulted from cosmic radiation.

The cosmic radiation is not very effective at this altitude of 360 miles. The primary cosmic radiations are not too intense and the trapped radiation is likewise not intense at this altitude. This does not begin to be serious until around 1,200 miles.

Mr. McDonough. Do we have any other animals we are going to make experiments on soon?

Colonel Holmes. We have primate colonies in several of our laboratories that could be utilized for many different types of activities. Their training could be directed toward any given experiment. We have no specific plan at the moment.

Mr. Riehlman. Would the gentleman yield?

Does the Air Force plan to place in orbit a live animal?

Colonel Holmes. I think they do, sir. I believe their program was also coordinated with NASA's intentions.

Mr. Low. The Air Force does have the Discoverer program. This is being coordinated very closely with the Department of Defense's Advanced Research Projects Agency. We are, of course, also familiar with their program.

I am not certain at this time whether the Discoverer program carries a military classification or not, and since it is an Air Force program, I would rather not discuss it in open session.

Mr. Fulton. Another point comes up.

How much of the information you have received scientifically will you release for the world's scientists generally? Do you intend to keep it largely secret, or are you going to make this an experiment on the order of those conducted in the International Geophysical Year?

Colonel Holmes. It is my understanding medical information will have no classification. It will be released to whoever wishes to use it.

Mr. Fulton. Will the classifications of the vehicle and the compartment, as well as the type of experiments you have made, and equipment be made public?

Colonel Holmes. So far as I know all of that will be released. Any portion that has direct implication to flight characteristics I presume will have to be couched somewhat differently.

But from the biomedical standpoint, I have had no guidance that any of that will be classified.

Mr. Fulton. How many g.'s was this animal subjected to on launching or takeoff as compared with the descent? What was the maximum?

Colonel Holmes. The approximate maximum I would say, was about 10 g.'s for takeoff.

Mr. Fulton. Why did it hit 30 on the descent? Was it because of any defect in the flight equipment, or was that expected?

Colonel Holmes. I am certain that was an expected situation.

Mr. McDonough. Will the gentleman yield?

There was no break on the descent at all?

Colonel Holmes. Not to my knowledge. The flight plan went off very beautifully.

Mr. McDonough. In other words, this project was fired as though it were a warhead aimed at a target, but without any warhead in the missile?

Colonel Holmes. There was no warhead. I don't know——

Mr. McDONOUGH. I mean it was fired in the same manner as if you were firing at a target. There was no attempt to break the descent at all?

Mr. LOW. May I answer that? There was a parachute deployed shortly before impact to preserve the capsules from the impact load of landing. In answer to Mr. Fulton's question about the g's, the acceleration on reentry depends upon the flight path and a missile flight path is considerably different from a satellite reentry trajectory.

A missile nose cone enters the atmosphere at a steeper angle than a satellite and the g's are a direct function of the angle of entry.

Mr. FULTON. So that on one of our projects flights with astronauts, if it is a descent from a satellite it probably will be in a more sloping curve, a longer time descent and less g's rather than more?

Mr. LOW. That is right.

Mr. FULTON. We would employ a series of parachutes, probably, because it would be a longer descent. Is that not right?

Mr. LOW. Yes. In the Mercury capsule there is a small parachute to be deployed at about 70,000 feet and a larger parachute at 10,000 feet.

Mr. FULTON. Did the monkeys have any ear stoppers to deaden noise?

Colonel HOLMES. No, sir.

Mr. FULTON. Don't you think that would be good?

Colonel HOLMES. Captain Augerson pointed out they did have a little helmet that might help some, but there was no effort made to plug the auditory valve.

Mr. TEAGUE. Is there noise? Do you know that there is noise in the nose cone?

Colonel HOLMES. That is an exceptionally good question. I don't believe I am qualified to discuss that particular aspect. Some of the information I have received seems to be conflicting.

Mr. FULTON. I have one final question.

At the height of this 360 miles that you have described, the conditions that would be existent there, that is, the extremes to which these monkeys would have been subjected, for example, is it still in the ionosphere or the stratosphere? What is the gravitational pull and the amount of radiation, if you could tell us, at that particular point in space?

Colonel HOLMES. Working backward on that, as Dr. Worf has pointed out, the radiation factor is not at the moment too great a hazard, because it is below the first Van Allen belt.

So far as gravitational influence is concerned, we are certainly at something less than orbital velocity, and something far less than escape velocity. I cannot supply the factor for the exact gravitational influence, but we are in a weightless state, of course, at this time.

So far as the temperature is concerned, we are in an area where the atmospheric particles are markedly reduced. Perhaps Dr. Worf can tell me what it is at this level, but the temperature range depends on actual solar influence on the vehicle.

Mr. LOW. Temperatures inside the capsules?

Mr. FULTON. No, I wanted the atmospheric or space conditions that might exist in the area that you went through. Then I was going to relate it to the total projected height for the X–15 flight. The X–15 will probably reach that same ballistic course.

Colonel HOLMES. I am going to need some help, but I think the altitude anticipated is much lower than that, around 120 miles. The figure of 120 miles, however, is used arbitrarily as outer space.

Mr. FULTON. The total ballistics course is about the same as the X–15 will have although the height is not as much?

Colonel HOLMES. Yes.

Mr. FULTON. The total ballistics force will be about the same and also the weightless state and lack of gravity?

Colonel HOLMES. I believe the weightless state will be less.

Mr. LOW. I believe the weightless time in the X–15 will be more in the order of 4 or 5 minutes.

The CHAIRMAN. May I ask you this question, Colonel?

The speed the missile reached, 10,000 miles an hour, lasted, you say, about 20 minutes?

Colonel HOLMES. No, sir. Let us take arbitrarily about 15 minutes.

The CHAIRMAN. The animal was in a condition of weightlessness about 20 minutes?

Colonel HOLMES. No, sir; about 10 minutes.

The CHAIRMAN. Then, on the return, one parachute was released just before impact with the water. What was the speed of the nose cone at the time of impact?

Colonel HOLMES. I don't believe I have that information and I am not sure that does not fall in the area of the flight characteristics which I believe carry some classification.

The CHAIRMAN. Of course, that would have something to do with the action of the heart, too?

Colonel HOLMES. Well, the impact——

The CHAIRMAN. Did you get any signals from the animal up to the time of impact?

Colonel HOLMES. To the time of the impact we do have telemetering data and we know the animals were in good condition up to that time.

The CHAIRMAN. That is up to the very instant of impact?

Colonel HOLMES. Yes, sir.

The CHAIRMAN. Then how long was the nose cone in the water before it was recovered?

Colonel HOLMES. I believe a little over an hour. Actually they had it alongside the ship. It was roughly 3 to 4 hours before all of the problems of getting it aboard the ship and getting the animals out were taken care of.

The CHAIRMAN. It was watertight?

Colonel HOLMES. Yes.

The CHAIRMAN. Was the surface of the ocean rough?

Colonel HOLMES. No, we had a very fortunate weather condition. The weather was fairly smooth and I would say the conditions for recovery were more or less ideal.

The CHAIRMAN. How were you able to locate the load? By dyes or by lights?

Colonel HOLMES. There was a marker and there were some identification bombs. There was a parachute in the package, which trailed behind the nose cone and also a balloon was inflated, and there were ships in the area and I believe at least one airplane.

Mr. TEAGUE. There was radio, too?

Colonel HOLMES. Yes.

The CHAIRMAN. Was there any portion of your identifying mechanism that did not work?

Colonel HOLMES. Not to my knowledge.

The CHAIRMAN. So, though it was at night, you had no problem?

Colonel HOLMES. It was early dawn and the visibility was getting better, of course, but so far as I know—I was not on the recovery ship—so far as I know the recovery technique went very well.

The CHAIRMAN. Were you able to follow the missile as it returned to the atmosphere and then, for the final plunge, were you able to follow that as to its impact location all right?

Colonel HOLMES. It was followed, and again I am a little bit hesitant here as to what should be discussed and what shouldn't.

The CHAIRMAN. Let me ask you this, then: There was no trouble in locating and identifying the nose cone?

Colonel HOLMES. Not to my knowledge.

The CHAIRMAN. After the impact with the water?

Colonel HOLMES. Not to my knowledge. It was found very speedily and pulled aboard very speedily.

The CHAIRMAN. Mr. Bass.

Mr. BASS. I assume, Colonel, it was completely dark inside this capsule?

Colonel HOLMES. No, we had a small light. Do you know the strength?

Captain AUGERSON. Actually it was a 40-watt bulb that was used to illuminate the capsule.

Mr. BASS. So the monkey could see?

Captain AUGERSON. I speak now of Able. I cannot remember whether there is a light in the smaller package, the Navy package. I will have to check.

Colonel HOLMES. I don't believe there was a light in the small package. There was in the larger one.

The CHAIRMAN. It would seem about time to wind up this briefing.

Mr. WOLF. I was wondering if something in outer space contributed to the death of this monkey. Have you any idea what factor might have been the one that contributed?

Colonel HOLMES. No, sir; I do not.

Mr. WOLF. Has there been any study or any thinking along this line?

Colonel HOLMES. No, I think the physical phenomena of outer space are becoming better and better identified. I know of nothing mysterious at the moment that might have attributed to the death.

The CHAIRMAN. Mr. Anfuso.

Mr. ANFUSO. You mentioned there was some proof there were noises inside the cone. Would that be from the instruments?

Colonel HOLMES. No, sir. I believe I stated this was an area where the evidence seems to be somewhat conflicting.

Mr. ANFUSO. If the evidence was conflicting, there was some evidence of noise inside?

Colonel HOLMES. No, I don't mean to imply that. I mean I don't know.

Mr. ANFUSO. I would like to make this final observation. Certainly, from what we have heard here this morning, the possibility or even the probability that space flight caused the death of this monkey has not been eliminated.

Would you agree with that statement?

Colonel HOLMES. I would rather approach it from the other direction and state that so far as we know, the flight itself had no influence on the death of that animal because we recovered him in what appeared to be excellent condition.

Mr. ANFUSO. But you would not make that a positive statement?

Colonel HOLMES. Well, I would make it positive that we recovered him in what I thought was excellent condition.

Mr. ANFUSO. But you would not be so positive as to say that space flight had nothing to do—was not a contributing factor to the death?

Colonel HOLMES. I believe, sir, that question is a philosophical one.

Mr. ANFUSO. All right.

The CHAIRMAN. All right. Thank you very much, Colonel. We appreciate all the information you have given us this morning.

Colonel HOLMES. Thank you, Mr. Chairman.

×